INCORPORATION OF CERTIFICATE OF CORRECTION CORRECTIONS INTO THE SPECIFICATION

The specification was objected to because it did not incorporate the changes made to the disclosure by the Certificate of Correction. Changes to the specification made by the Certificate of Correction are incorporated herein without underlining or brackets.

Please replace Sheet 6 of 6 with the attached Sheet 6 of 6, wherein in FIG. 8 Reference Numeral "206" was changed to "206a" in accordance with the Certificate of Correction.

Please replace the paragraph beginning at col. 3, line 49, with the following:

A modified electrochemical CO room temperature gas sensor using a planar or tubular sensor design was a subsequent development to the earlier tubular design CO sensor. In order to overcome the problem that the Nernst potential is not zero in clean air experienced with the earlier tubular design CO sensor, the improved design proposed a four probe measurement method for CO gas detection. The improved design achieved a zero reading in clean air, and the improved sensor was insensitive to variations in relative humidity. Theoretical analysis based on electrochemistry, however, indicates that there is no difference between the four probe method and the normal two probe method of the earlier tubular design CO sensor. The improved sensor still used electronic conductors for both the sensing and counter electrodes, and showed slow and weak response signals to CO gas.

Please replace the paragraph beginning at col. 4, line 52, with the following:

A further aspect of the inventive gas sensor is that either two electrodes or three electrodes are required, whereas prior art gas sensors always require three electrodes and a DC power supply.

Please replace the paragraph beginning at col. 6, line 38, with the following:

Resistance of an electrochemical cell includes at least three components: 1) bulk ionic resistance of the membrane, 2) interface resistance between the membrane and electrodes, and 3) electronic resistance of the electrodes. The bulk ionic resistance of the sensor is reduced to about 1 ohm by the inventive sensor design, such that R_{bulk} is not a performance limit. Electronic resistivity of the electrodes is in order of 10^5 ohm-cm and is not a performance limit. Therefore, the interface resistance, which is relative to the available three-phase contact area, becomes the performance limit. The interface resistance of the sensor according to this invention has been reduced by introducing mixed proton-electronic conductor, or alternatively, a thin film electron conductor electrode.

Please replace the paragraph beginning at col. 7, line 27, with the following:

In Fig. 2, electrical leads 50, 22 are connected to a switching mechanism for sensor 10 made up of a switch 40 that is opened and closed by unit 42 so as to alternately provide a power source 44 in electrical communication with cap 32 and can 30 of sensor 10. Unit 42, and related circuitry, serves as an example and illustration of a means for applying a DC power across the protonic conductive electrolyte membrane, and switch 40 and related circuitry serves as an example and illustration of a switch means for alternating the connection between the sensing and counter electrodes from the electrical measurement means to the DC pulse power means.

Please replace the paragraph beginning at col. 8, line 21, with the following:

Protonic conductive membrane 12 will preferably be a solid proton conductive electrolyte membrane coated with a catalyst on both sides thereof. The solid proton conductive electrolyte membrane is composed of an organic material, such as a polymer material, or may also be composed of an inorganic material such as a metal oxide. Where the solid protonic conductive electrolyte membrane is an organic membrane, the organic membrane will preferably be a polymer proton conductive material such as NAFION™ 117, or XUS-

1304.10 membrane, NAFION is manufactured by DuPont and XUS is manufactured by Dow Chemical Co. of the United States of America. Alternatively, the organic material may be a R4010-55 membrane supplied by PALL RAI Co., also of the United States of America.

Please replace the paragraph beginning at col. 8, line 35, with the following:

In the inventive sensor design as shown in FIG. 2, it is desirable that both area and thickness parameters are optimized. It is beneficial for CO sensor 10 to have a 0.1 mm-1 mm thick NAFION™ protonic membrane, and that the diameter of sensing and counter electrodes 16, 14 be approximately 1 mm to 15 mm. Preferably, CO sensor 10 has a 0.17 mm thick NAFION™ protonic membrane or the like with 10 mm diameter sensing and counter electrodes 16, 14, which results in a bulk ionic resistance of 1.0 ohm. The proton conductor for both the sensing and counter electrodes is preferably a copolymer based on a tetrafluoroethylene backbone with a side chain of perfluorinated monomers containing sulfonic or carboxylic acid groups, especially a NAFION™ 117 material from DuPont, or a R4010-55™ material from Pall RAI Manufacture Co., or the like.

Please replace the paragraph beginning at col. 8, line 50, with the following:

Where the solid proton conductor of electrolyte membrane is composed substantially of inorganic materials, such as a metal oxide proton conductive material, then it is preferable that the metal oxide proton conductive material be Sb_2O_5-$4H_2O$ as a composition of materials.

Please replace the paragraph beginning at col. 8, line 64, with the following:

Preferably, counter electrode 14 and sensing electrode 16 will have a thickness of approximately 0.1 mm and a diameter of approximately 13 mm. Also preferably, hole 202 will have a diameter of 3 mm and hole 206 will have a diameter of 0.2 mm, each hole being in the center of its respective piece. Preferably, microporous hydrophobic membrane 204 will have a thickness of 0.1 mm and a diameter of 10 mm. Preferably, protonic conductive

membrane 12 will have a thickness of 0.1 mm and a diameter of 20 mm. It is preferable that protonic conductive membrane 12 be less than 1 mm in thickness so that the resistance of the same will be desirably low. It is desirable to have a small proton resistance so that the proton electrical current that is generated as a result of pressure differences of the target gas CO across protonic conductive membrane 12 without applying a DC power. The background electrical current will be preferably in the nA range or less, which is negligible.

Please replace the paragraph beginning at col. 9, line 14, with the following:

As an alternative to manufacturing counter electrode 14 and sensing electrode 16 from mixed protonic electronic conductive materials, a thin film of electrically conductive film, such as noble metal film which is deposited upon protonic conductive membrane 12, may also be used in replacement for such electrodes. Preferably, the thin metal film will be deposited by sputtering or physical vapor deposition, or other known methods of depositing a thin metallic film, where the film is permeable to water vapor. Such a film is seen in FIG. 6, discussed below.

Please replace the paragraph beginning at col. 11, line 14, with the following:

A DC power source 140 is in electrical contact with first pump electrode 115 and metallic can 130 through electrical contacts 146 and 144. DC power source 140, and related circuity, serve as an example of a means for applying a DC power across the protonic electrolyte membranes. Sensing electrode 116 is in contact with an electrical measurement means 142 through electrical leads 146, 144. DC power supply 140 serves as a CO pump to sensor 110. By way of example and illustration of an electrical sensing means, a meter 142 is used to measure the response of sensor 110 to concentrations of CO.

Please replace the paragraph beginning at col. 11, line 42, with the following:

FIG. 5A shows sensor voltage response with respect to time of the inventive one protonic conductive membrane gas sensor seen in FIG. 2. Reference point 90 shows zero time with a

negligible CO concentration. Reference point 92 shows an environment of 100 ppm CO after a period of less than one minute. At reference point 93 on FIG. 5A, an injection of 200 ppm CO is made into the environment such that sensor responses maximizes at reference point 94a on FIG. 5A. At reference point 94b on FIG. 5A, the atmosphere is seen to be opened up to clean air and the sensor response decreases by a slight under shoot to reference point 94c on FIG. 5A after a period of about one minute. The senor response levels back to zero amps as time goes on from reference point 94c. FIG. 5A reflects environmental parameters of 23° C. and 35% relative humidity. Such a sensor current response is seen in a nonlogrithmic scale in FIG. 5B.

Please replace the paragraph beginning at col. 12, line 17, with the following:

Alternative embodiments of the inventive sensor are depicted in FIGS. 6 and 7, where the protonic conductive membrane is seen in two parts. Particularly a nonplanar surface of protonic conductor membrane 12 is seen at portion 12a thereof. A planar surface of protonic conductor membrane 12 is seen in portion 12b thereof. By increasing the surface area of portion 12a via a nonplanar surface, greater contact with the materials of the catalyzing and electrical conducting electrode thereover is possible. A greater contact will ensure a greater conductivity of protons and electrons therethrough as well as a greater surface upon which to catalyze. The creation of such a nonplanar surface may be accomplished by a chemical or physical abrasion process, or by other known method.

Please replace the paragraph beginning at col. 12, line 31, with the following:

FIG. 6 illustrates an example of an electrode made of an electrically conductive thin film situated upon a protonic conductive membrane. The film has an average thickness in the range of about 50 Angstroms to 10,000 Angstroms, and will preferably be in the range of about 4,000 Angstroms to 6,000 Angstroms. The preferable film is substantially composed of a noble metal, such as platinum. The film may be deposited on protonic conductive membrane 12 by sputter, or by vapor deposition techniques, or by other known film layering techniques.

Please replace the paragraph beginning at col. 12, line 63, with the following:

FIG. 7 shows a mixed protonic-electronic conductive electrode having a protonic conductive membrane 12, a current collector electrical lead 22, and a variety of amplified particles therebetween and consisting of an electronic conductive phase material 82, and a protonic conductive phase material 84. Between particles of protonic conductive phase material 84 and electronic conductive phase material 82, there are gaps 80 which represent the pores between the particles situated between current collector electrical lead 22 and protonic conductive membrane 12. Electrons are transmitted to current collector electrical lead 22 when CO gas in the ambient comes in contact with three-phase contact area 86. Hydrogen ions are transported to protonic conductor membrane 12 when CO gas in the ambient comes in contact with three-phase contact area 86. The creation of both hydrogen ions and electrons occurs at each of the plurality of three-phase contact areas 86 shown in Figure. 7. Neither electrons nor hydrogen ions are created at interface 88 which is situated between protonic conductive membrane 12 and protonic conductive phase material 84. Similarly, no reaction to create electrons or hydrogen ions occurs at an interface 88 between current collector electric lead 22 and electronic conductor phase material 82.

Please replace the paragraph beginning at col. 15, line 63, with the following:

D. For Carbon/Ru Oxide electrode preparation, the following steps are taken: